

Autonomic nervous system

Definition : Portion of nervous system that controls visceral functions
It is organised on basis of the reflex arc; integrated at different levels

Somatic n.s	Items	Autonomic n.s
Ant. horn cells	1 Cell	Lat. horn cells or corresponding cranial motor nuclei
① efferent neurone system	2 Fibre	② efferent neurone system pregang & postgang. neurones
① type Aα fibres 25-100 m/s	3 Function	② types sympathetic & parasympath.
① supply only skeletal m.		② supplies muscles or glands smooth or cardiac ms exocrinal or endocrinal glands
① ch. transmitter Acetylcholine <u>VOLUNTARY</u>		② ch. transmitters Acetylcholine and noradrenaline <u>INVOLUNTARY</u>

N.B Autonomic and somatic fibres pass together in ventral root of spinal nerves
Autonomic ganglia: « نظري فقط »

• Definition : Collection of postgang. neurones outside CNS

N.B Nucleus : collection of neurones inside CNS.

• Function : Distributing Centres

i.e Each pregang. (B fibre thin myelinated long) fibre synapses & activates 8-9 postgang. (C fibre unmyelinated short) fibres.

• Types : 5

① Paravertebral = lateral = Sympathetic chain

On both sides of vertebral column ; each segment of sp. cord has a pair of ganglia with the exception of cervical region, there are only 3 pair of ganglia (superior, middle & inferior)

② Collateral ganglia At origin of big vessels arising from abdom. aorta.
They are named after them ; celiac, superior mesenteric & inferior mesenteric

Both lateral and collateral ganglia are sympathetic ganglia ①

③ Terminal ganglia Near or in visceral organs (parasymp. ganglia)

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منه؟ sympathetic ganglia are usually terminal, with very long pregang. fibres
 5 Other parasymp. ganglia include ciliary, sphenopalatine, submaxillary
and otic ganglia which are present in head & neck.

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and otic ganglia which are present in head & neck.

5 Adrenal medulla: modified sympathetic ganglion in which the
postgang. neurons have lost their axon & become secretory cells.
 (tailless) (adrenaline)

Sympathetic nervous system

- Origin: Lat. horn cells of thoraco-lumbar i.e. All ¹² thoracic & upper 3 lumbar
- Relay: Lateral (paravertebral symp. chain) and collateral ganglia
- Functions: Emergency i.e. fight or flight (alarm or stress response) Catabolic

4 Head & neck

Origin upper TWO thoracic Relay Cervical ganglia

- 1 Eye • Pupillodilatation (Mydriasis) • Elevation of upper eye lid. Exophthalmos
 • -- tear • VC of conjunctival vs • Relaxation of ciliary ms i.e. far vision
- 2 Skin • Sweating • VC of cutaneous vs • Cont. of piloerector ms i.e. hair erection
- 3 Salivary glands (mainly submaxillary) trophic i.e. small, concentrated & viscid.
- 4 Cerebral circulation ++ bl. flow due to ++ ABP mild VC or VD of cerebral vs

N.B Horner's syndrome Lesion on one side of cervical sympathetic chain

Effects: Eye Ptosis = Drooping of upper eye lid

Miosis = Pupilloconstriction Exophthalmos

Skin Anhydrosis = no sweating

Vasodilatation → warm red skin.

5 Thorax

Origin upper FOUR thoracic Relay cervical & upper 4 thoracic gang.

- 1 Heart ++ All cardiac properties i.e. rate, force of contraction & excitab.
MCQ Vasodilatation of coronary blood vessels
- 2 Lungs Bronchodilatation and pulmonary VC

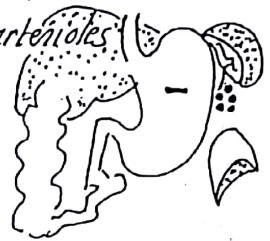
6 Abdomen Greater splanchnic nerve

Origin lower SIX thoracic Relay collateral gang [coeliac]

(2)
 sup. mesenteric
 inf. S

Abdomen: origin: lower 6 thorax → Relay: Coll. gang.

- 1 GIT Inhibition of wall of stomach, small intestine & proximal $\frac{1}{2}$ of large intestine
Motor to sphincters e.g. pyloric sphincter
- 2 Bl vessels VC of most arterioles & VD of some arterioles
- 3 Liver Glycogenolysis → ++ bl. glucose
- 4 Spleen Contraction → ++ RBCs in bl.
- 5 Adrenal medulla 80% adrenaline & 20% noradren.



Pelvis Lesser splanchnic nerves [Pre sacral] [division RT. L. 8. 10. 11]

Origin FOUR 12th upper 3 lumbar Relay Collateral g. inferior mesenteric

- 1 GIT inhibition of wall of distal part of large intestine and rectum
contraction of internal anal sphincter → retention of feces

- 2 Urinary bladder Inhibition of wall of urinary bladder
contraction of internal urethral sphincter → retention of urine

3 Male genital organs

a Ejaculation of semen: contraction of vas deferens, seminal vesicles and prostate

b Shrinkage of penis: VC of bl vs of penis and pelvic organs.

- 4 Female genital organs variable effect on uterus depends on stage of menstrual cycle

Parasympathetic nervous system

Secreto-motor system

- Origin Cranio sacral i.e. Cranial nerves III, VII, IX & X & 2, 3, 4 sacral → pelvic nerve
- Relay Terminal and other ganglia.
- Functions Stimulatory to GIT & urinary system & inhibitory to heart i.e. Anabolic

Nerve	Nucleus	Ganglion	Functions
III Oculomotor	Edinger Westphal midbrain	Ciliary	1 Pupilloconstriction i.e. miosis 2 Cont. of ciliary ms → ++ power of lens i.e. near vision
VII Facial	Superior Salivary in lower pons	Submandibular Sphenopalatine	++ saliva from submand. & sublingual salivary glands and VD ++ secretion of lacrimal and nasal glands
IX Glossopharyngeal	Inferior Salivary pons & medulla	Otic	++ saliva from parotid gland and VD (3)

Nerve			WHR, XWB force constriction
Nucleus	Ganglion		
X Vagus	Vagal	Terminal	1 Heart inhibition of atria only & coronary VC Vagus doesn't supply ventricles 2 Lung Bronchoconst ++ bronchial secretion & pulmonary VD 3 GIT Motor to esophagus, stomach, small intestine & Proximal half of large intestine. Inhibition of sphincters ++ gastric, intestinal, pancreatic & bile secretion 4 Gall bladder evacuation i.e motor to wall & relaxation of Oddi sphincter
Pelvic nerve nervi erigentes انتصاب	2nd, 3rd & 4th sacral segments	Terminal ganglia	1) Defecation & micturition by contraction of wall of rectum & urinary bladder & relaxation of internal sphincters 2) Erection of penis & clitoris ++ prostatic & seminal vesicle secretion

N.B Head and neck (III VII IX) Thorax and abdomen (X) Pelvis (plevic n)

Centres	Autonomic reflexes
1 Sacral segments	Micturition, defecation and erection.
2 Medulla oblongata	Respiration and Cardio-vascular reflexes e.g ABP.
3 Mid brain	Eye reflexes e.g light reflex & accommodation.
4 Hypothalamus	Reflexes that maintain temp. & chemical constancy of ECF.
5 Hypoth and Limbic cortex	Emotional and behavioral reflexes.

2 main chemical transmitters at autonomic junctions : [Acetylcholine
Noradrenaline

● Acetylcholine is released by cholinergic fibres & received by cholinergic receptors

● Synthesis : At synaptic knobs of terminal endings of cholinergic fibres

● Choline is formed and also actively uptake by cholinergic neurones

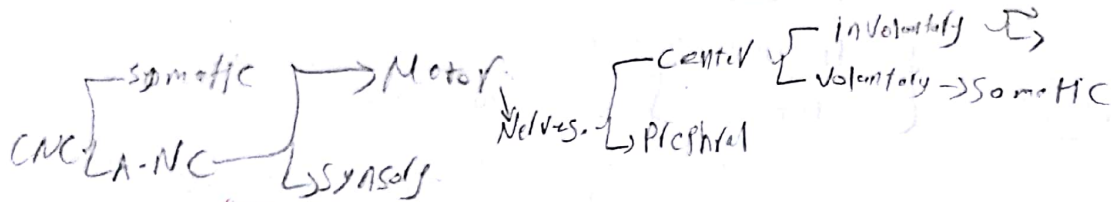
● Acetate is activated by reduced coenzyme A to give Acetyl-CoA
Acetyl-CoA + choline choline acetyl transferase → Acetylcholine

● Synthesis occurs in axoplasm and acetylcholine is stored in clear vesicles

● Release : Action potential increases permeability to Ca^{++} which causes vesicles to fuse with membrane & empty & release acetylcholine by exocytosis

● Removal

(4)



Cholinergic Fibres	Cholinergic receptors	Stimulants	Blockers
- Central cholinergic fibres - All somatic fibres - All preganglionic fibres - preganglionic sympath - preganglionic parasymp - preganglionic sympath to adrenal medulla	- Central - Nicotinic receptors - At motor end plate i.e. neuro-muscular junction. - At skeletal muscles - All autonomic ganglia - At postganglionic neurones	- Nicotinic drugs & Site - Nicotinic receptors - Nicotinic small dose e.g. - Atropine - Anticholine esterase - eserine = physostigmine - prostigmine = neostigmine - Di-isopropyl fluorophosphate (war. poison) - Stimulate all A. ganglia	- Acetylcholine antagonists: - Nicotinic blockers - Nicotine large dose - Tetraethyl ammonium (TEA) - Hexa methonium - Neuro-muscular blockers - Curare - Curare - Muscarinic blockers = parasympatholytic - Site block muscarinic receptors - e.g. Atropine, Homatropine.
- Peripheral-cholinergic fibres - All postganglionic parasymp - Some postganglionic sympath - to sweat glands - vasodilator fibres to bl vs of sk. muscles	- Peripheral - Muscarinic receptors - All organs supplied by postganglionic parasymp - Some organs supplied by postganglionic sympathetic - sweat gland - bl. vs of sk. muscles	- Muscarinic drugs = parasympathomimetics - Site Muscarinic receptors - e.g. Muscarine, Pilocarpine, Metacholine - Anticholine esterase	- Muscarinic blockers = parasympatholytic - Site block muscarinic receptors - e.g. Atropine, Homatropine.

Prevent application of AChR with AChE inhibitors
 Acetylcholine antagonists prevent action and not formation of acetylcholine

Removal of acetylcholine

Pharmacokinetics

↓ 1. R

↓ 2. R

Acetylcholine $\xrightarrow{\text{acetylcholine esterases}}$ Acetate ion + choline

a true or specific cholinesterase : in membrane of cholinergic nerve ending and in synaptic area bound with the local collagen.

b pseudo or nonspecific cholinesterase : in plasma.

● Noradrenaline released by adrenergic fibres is received by adrenergic receptors

● Site of formation At all postganglionic sympathetic fibres except two adrenal gland and S.N.

● Synthesis in terminal endings of adrenergic fibres also in adrenal medulla

• In liver : Phenylalanine $\xrightarrow{+OH, \text{Hydroxylase}}$ Tyrosine

• In axoplasm of adrenergic nerves : Tyrosine $\xrightarrow{+OH, \text{Hydroxylase}}$ DOPA

DOPA $\xrightarrow{-CO_2, \text{Decarboxylase}}$ Dopamine

• In granulated vesicles : Dopamine $\xrightarrow{+OH, \beta\text{-Hydroxylase}}$ Noradrenaline

N.B. " " noradrenaline is bound to ATP and Ptn (chromogranin)

● Storage In adrenal medulla Noradrenaline $\xrightarrow{+CH_3, \text{N methyl transferase}}$ Adrenaline

● Release The same as acetylcholine. AP $\rightarrow$ + Pholigen gated Ca channel $\rightarrow$ exocytosis

● Removal of noradrenaline within few seconds in three different ways

1. Active reuptake of 50-80% of noradrenaline by adrenergic n. endings

2. Diffusion away from receptors into body fluids and blood $\rightarrow$ MAO

3. Destruction by enzymes

a MAO (monoamine oxidase) on outer mem. of mitochondria in adrenergic nerve fibres, brain liver and kidney (deamination).

b COMT catechol O methyl transferase in all tissues except

adrenergic nerve fibres and brain (methylation)

● Adrenergic receptors + first release

● Post-synaptic receptors

on organs

● Pre-synaptic

Alpha receptors

Beta receptors

Mostly excitatory i.e. contraction

Mostly inhibitory i.e. relaxation

Pupillodilatation Vasoconstriction

Bronchodilatation and vasodilation

MS Cont

Alpha receptors	Beta receptors
<u>Contraction</u> of GIT sphincters spleen, seminal ves. & prostate <u>Exception</u> Intestinal relaxation	<u>Relaxation</u> of GIT wall, urinary bladder wall and uterus <u>Exception</u> Heart ++ rate and force (β_1) <u>Hormones</u> ++ secretion <u>Metabolism</u> lipolysis, glycogenolysis
<u>Types</u> : α_1 α_2 <u>Mechanism</u> : α_1 ++ intracell. Ca^{++} α_2 $\Rightarrow$ intracell. cAMP Noradrenaline excites $\alpha > \beta$ recept.	<u>Types</u> : β_1 Heart & β_2 <u>Mechanism</u> : β_1 & β_2 stimulate adenylyl cyclase $\rightarrow$ ++ cAMP Adrenaline excites α & β recept. equally

N.B Isoprenaline (synthetic hormone) has a stronger action on β & no action on α Recept
Receptors are classified based on the sensitivity to certain drugs

- ① Presynaptic receptors: On membrane of postganglionic adrenergic fibres
- α_2 receptors: -- release of noradrenaline.
 - β receptors: ++ release of noradrenaline.

Drugs augment symp. activity

A Ganglionic stimulants (page 5) WSD

B Sympathomimetic drugs

act on adrenergic fibres or receptors

① Drugs ++ release of noradrenaline

Ephedrine Amphetamine
Tyramine

② Drugs stim. α adrenergic recept.

Noradrenaline α, β Phenylephrine
Adrenaline α, β

③ Drugs stim β adrenergic recept.

Adrenaline Isoprenaline.

Drugs depress symp. activity

A Ganglionic blockers (page 5) NLD TEA

B Sympatholytic drugs

① Block synthesis & storage of noradrenaline

Reserpine Guanethidine (ismelin)

② Block release of noradrenaline
Guanethidine

③ Form false transmitter

Methyldopa (aldomet)

④ Block α recept. Phentolamine (Rigite)
Phenoxybenzamine

⑤ Block β recept. Propranolol

(7)

M.C.Q.

Adrenal medulla

Modified sympathetic ganglion page 2

Acetylcholine is the ch. transmitter at adrenal medulla that releases

Adrenaline = Epinephrine

Noradrenaline = Norepinephrine

- 80% of adrenal medulla secretion
- Chemistry Methylated noradrenaline
- Inactivation Mainly by methylation
- Action Equal on α & β recept
.. Effect lasts 5-10 times longer
(removed from blood slowly)

20%

It lacks CH_3 group at N position

Mainly by active reuptake 50-80%
Strong on α recept. & slight on β recept.

Greater effect on heart (β_1)

Greater VC on bl. vs of sk muscles (α)

Total peripheral resistance
→ TPR → ++ ABP

Alarm Or Stress response of symp. nervous system

Catabolic system. $\text{glucose} \rightarrow 25\% \rightarrow 75\% \rightarrow \text{glucose}$

Symp. n.s. discharges as one unit in emergency e.g. Fight or Flight.

1 Stimulates glycogenolysis & lipolysis → ++ glucose & FFA (more energy)

2 Bronchodilatation → more O_2

3 ++ Heart rate, force of cont. & ++ ABP → more perfusion of sk. ms and vital organs

4 Pupillo dilatation & elevation of upper eye lid → ++ Field of vision.

5 VC of skin bl. vessels which limits bleeding from wounds

6 Lowers threshold in reticular formation in brain → alert & aroused state.

Parasympathetic system is anabolic = energy preserving

1 ++ energy production : Stimulatory to GIT (VII, IX, X and pelvic nerve)

2 -- energy consumption : -- Heart rate & pupilloconstriction in sleep.

Notes No parasymp. supply to Skin Sk muscles (limbs & abdominal wall).

Ventricle, spleen and adrenal medulla)

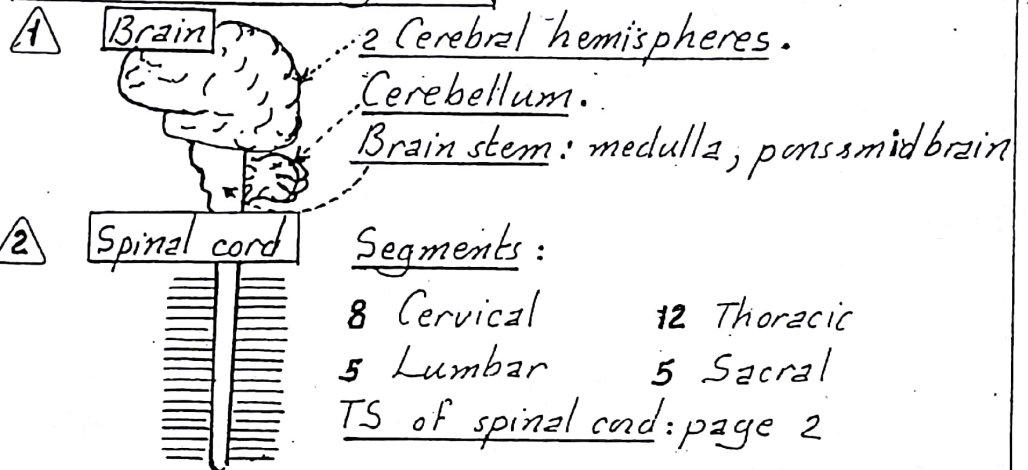
Preganglionic sympathetic fibre may synapse with postgang. neurone in the 8

- ganglion it enters
- pass without relay & synapse in the nearest ganglion
- collateral ganglia after it leaves the symp. chain

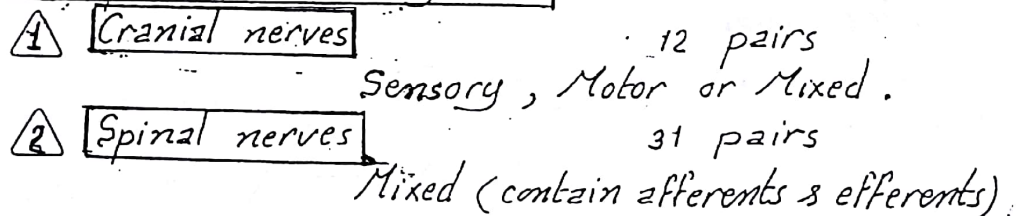
Autonomic nervous system

The nervous system

A Central nervous system

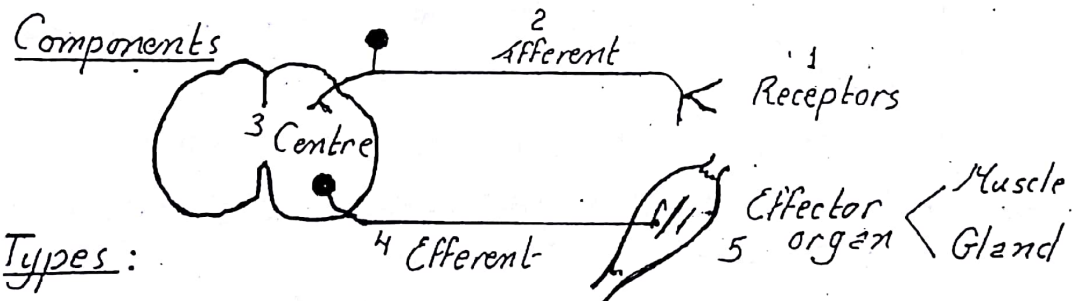


B Peripheral nervous system

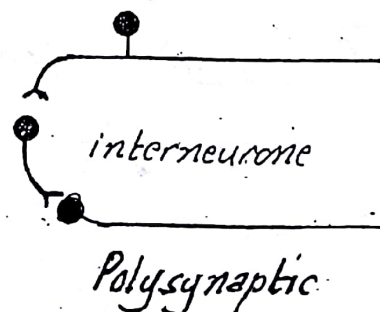
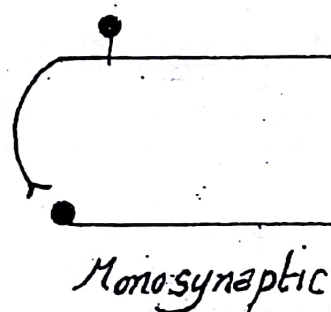


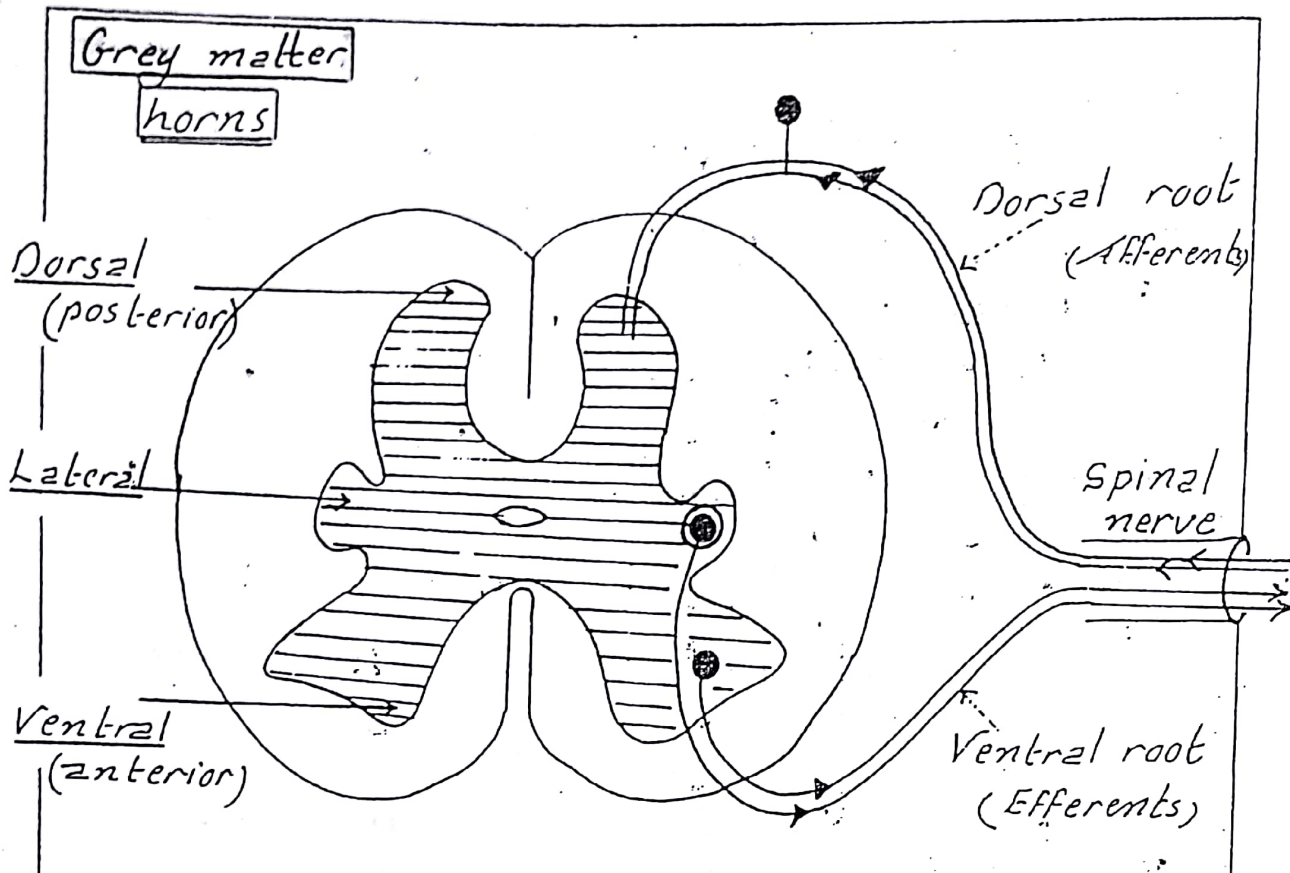
Reflex arc.

Functional unit of the nervous system.

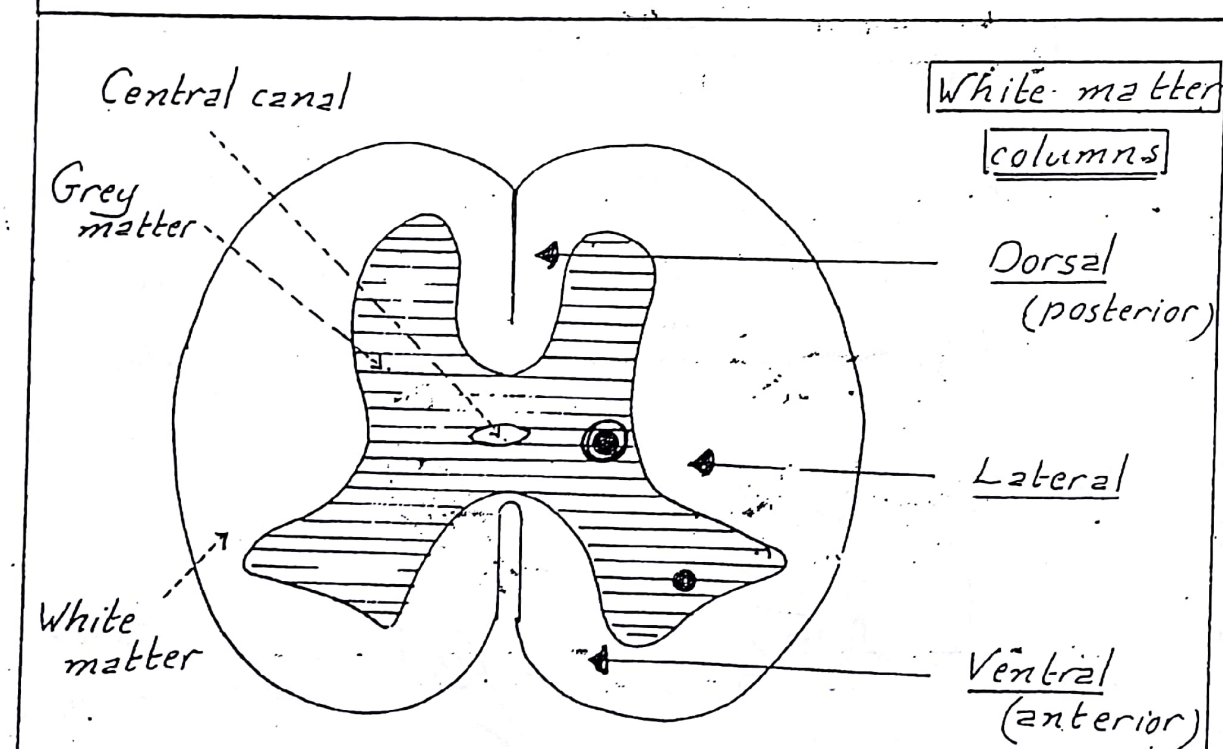


Types:



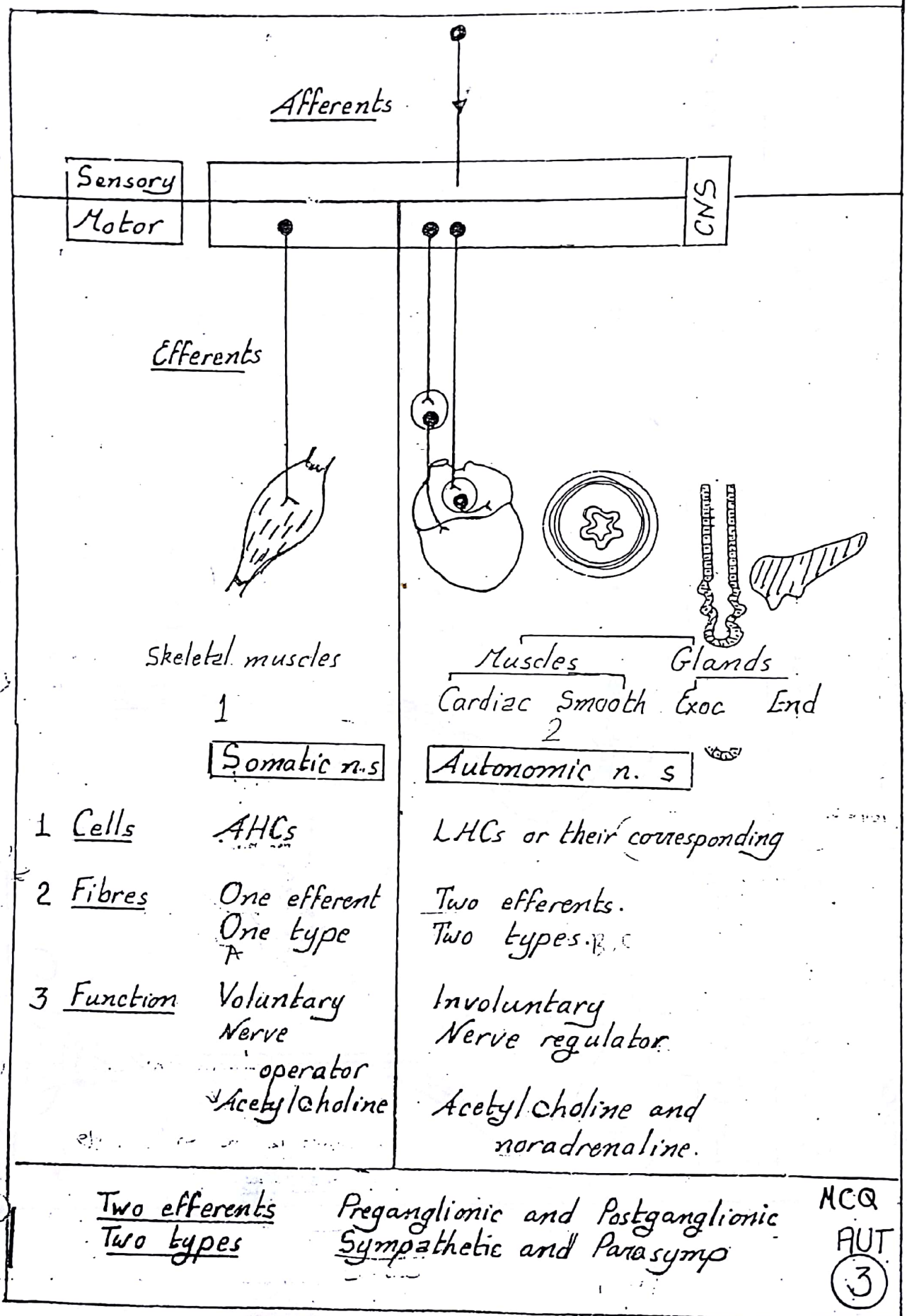


TS of sp. cd. (all thoracic & upper 3 Lumbar)



TS of sp. cd. (rest of segments)

AUT

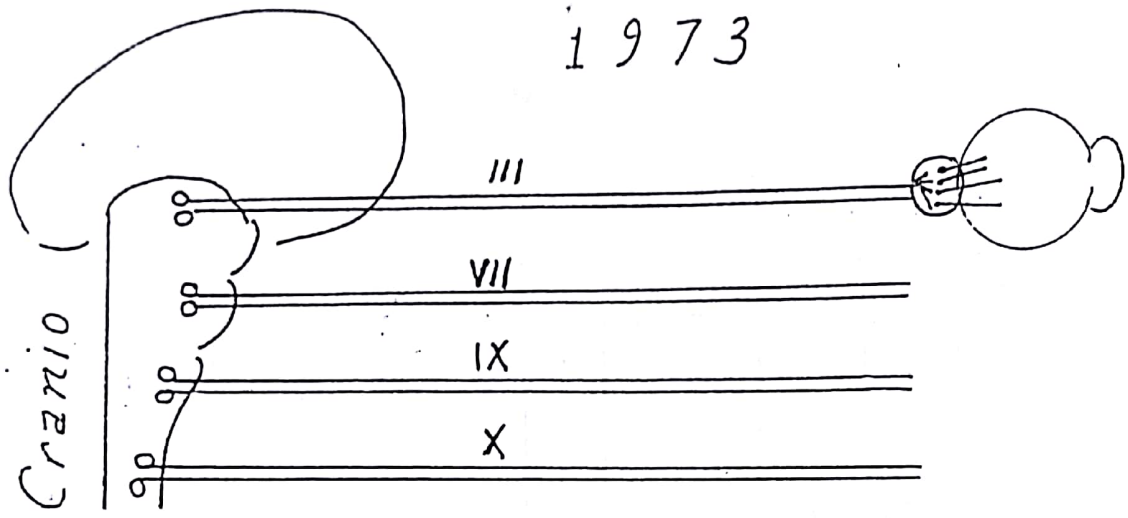


A.N.S

Anatomical considerations:

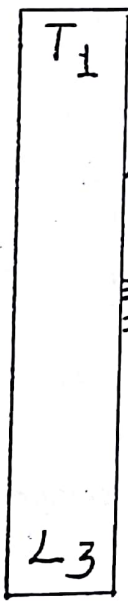
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Para



Sympathetic

Thoraco-Lumbar

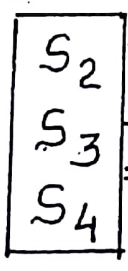


B

C

Para

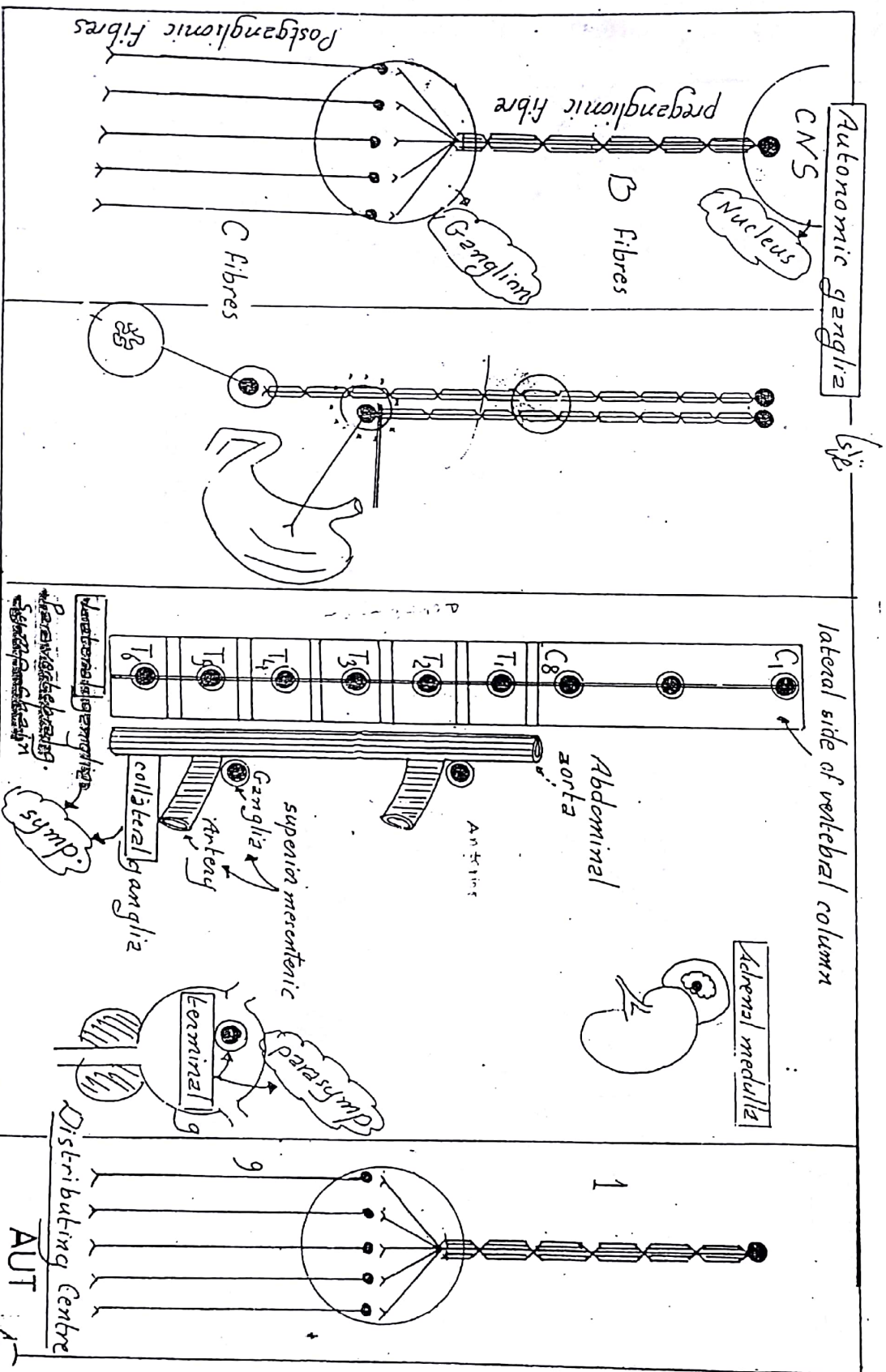
Sacral



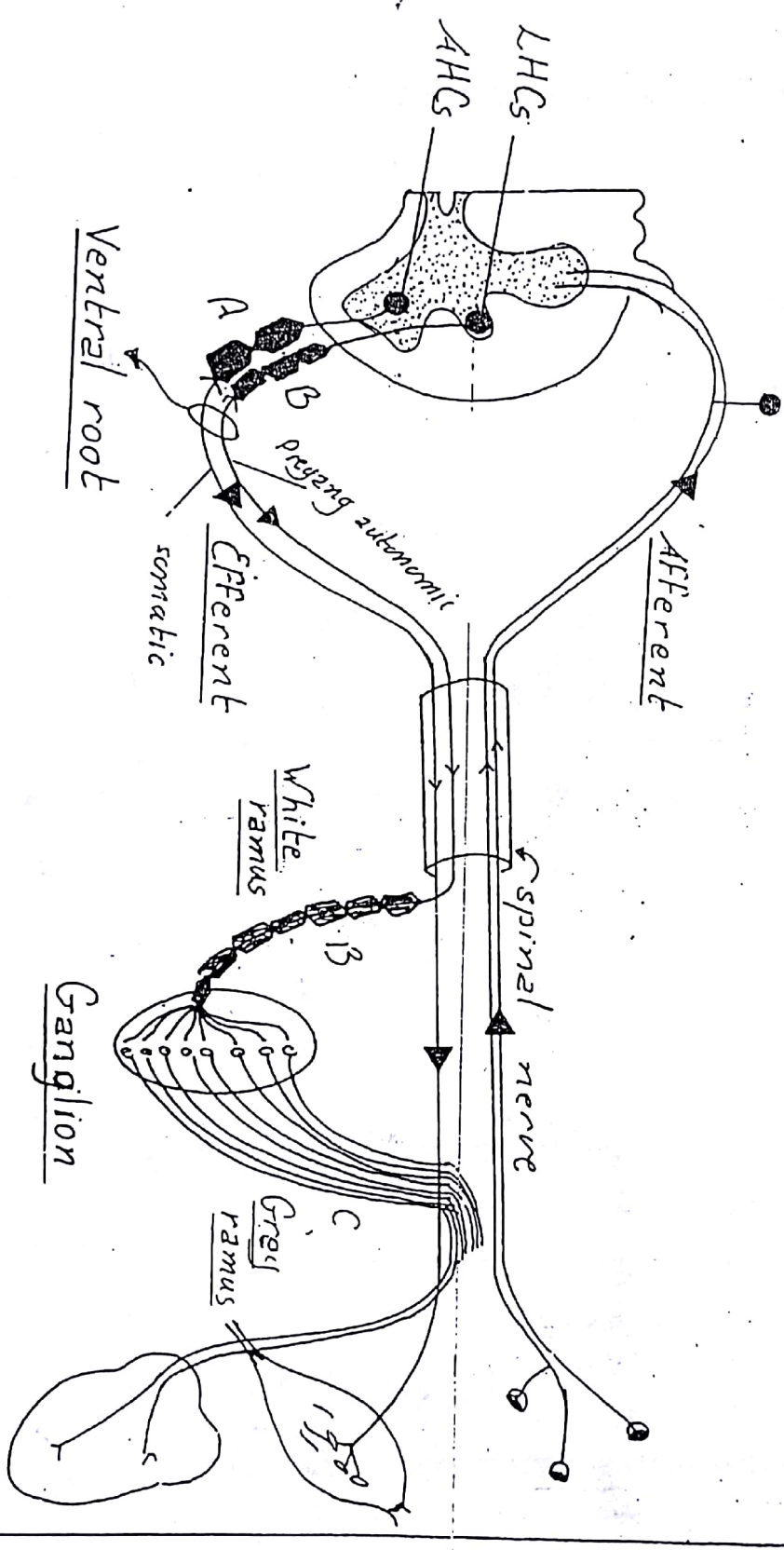
B

C

4



Course of somatic and autonomic nerves



Integration of sympathetic n.s.

Catabolic

Emergency

Fight or Flight

Energy

1

Glucose + FFA

Liver

+ Lipid

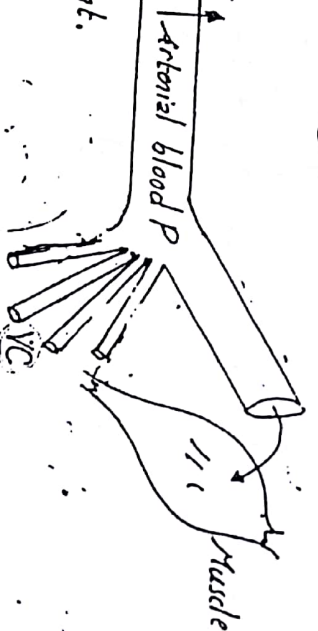
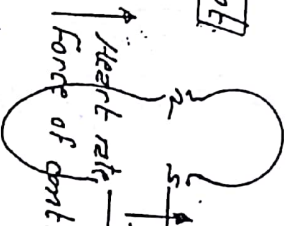
Lungs

transport Cardiovascular system

Glycogen Olysis

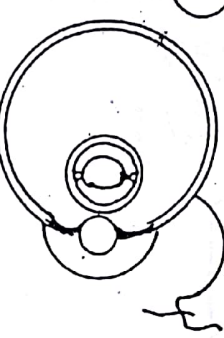
Lipolysis

Bronchodilat.



2

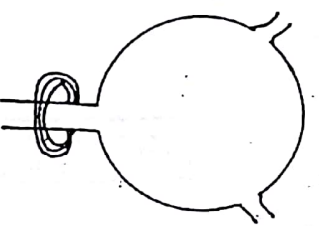
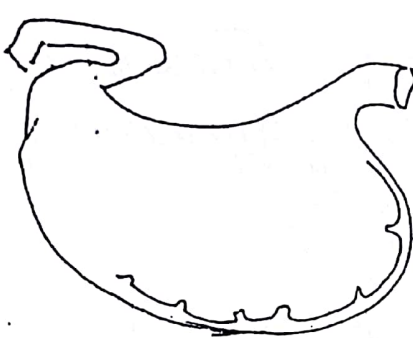
Elevation of upper eye lid.
Pupillodilatation.



3

(relaxation)

Inhibition of gastro-intestinal tr.
& urinary bladder.



ie inhibition of wall
& cont. of sphincters
(Motor)

a

Adrenal medulla

80% adrenaline

20% noradrenaline

Prolong & augment symp action
10 times

b

Lower the threshold of RF

ie more excitable

→ alert

c

Vasocnst. to skin blood vessels

→ -- bleeding

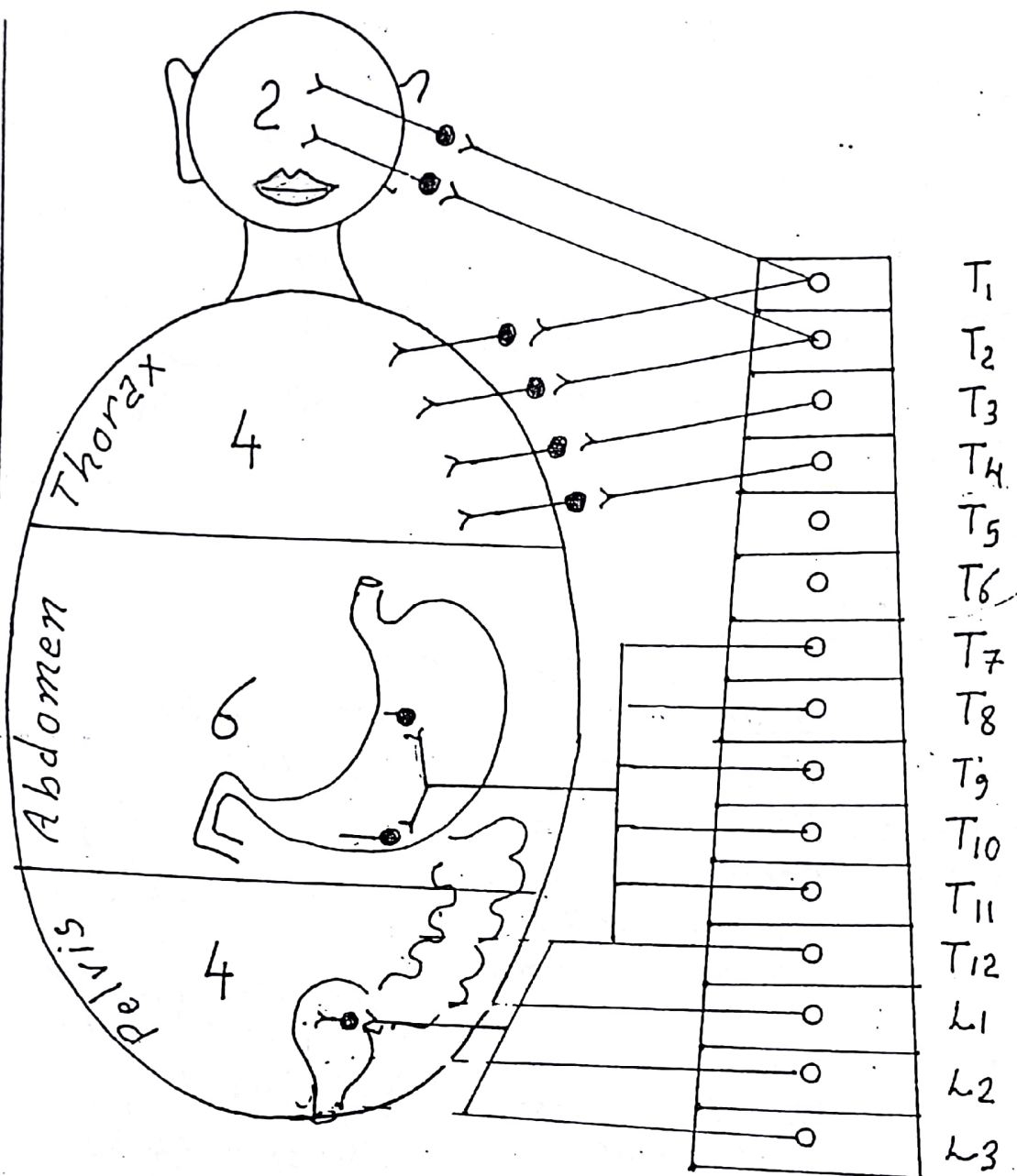
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Origin and relay of sympathetic n.s

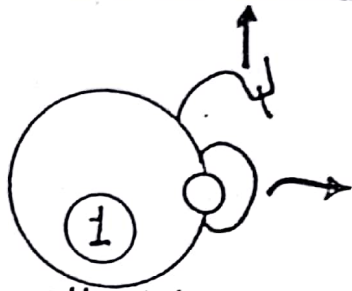
LATERAL GANGLIA

COLLATERAL GANGLIA

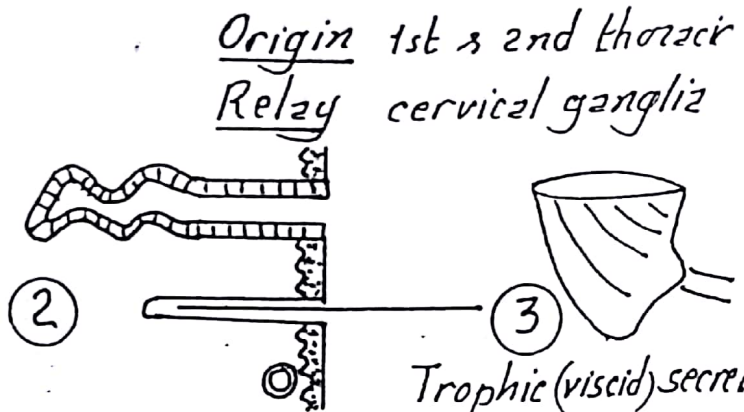


Functions of sympathetic nervous system

Head and neck



Pupillo dilatation
Elevation of upper eye lid
Exophthalmos
VC conjunctiva
-- tear secretion



Sweating
Erection of hair
VC

Trophic (viscid) secretion
Squeezing
VC

(4) Cerebral circulation
++ ABP
VC or VD

Horner's syndrome

Injury of symp. supply of head & neck

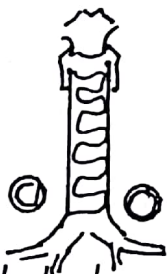
Eye

- Ptosis
- Miosis
- Enophthalmos

Skin

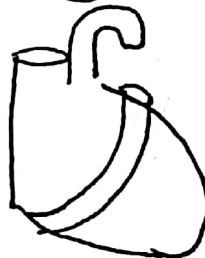
- Anhydrosis
- VD red swarm

Thorax



Broncho dilatation
Pulmonary VC

Origin upper & thoracic
Relay cervical upper & th



↑ Cardiac properties
Coronary VD

Aut

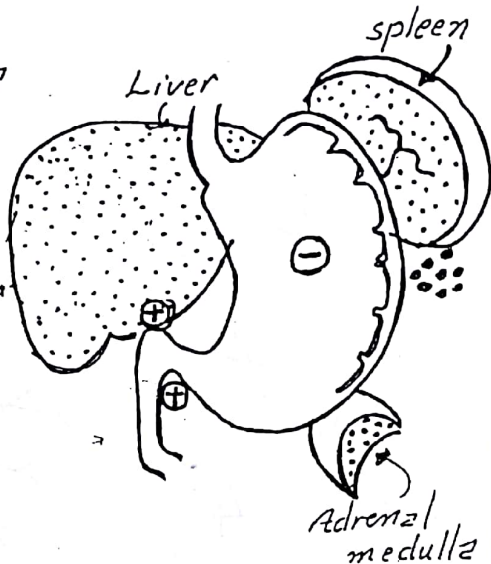
(9)

Abdomen

Greater splanchnic nerve

origin lower 6 thoracic.
relay collateral ganglia.

Liver : Glycogenolysis
 → Hyperglycaemia
Spleen : Contraction
 → ++ HV
Adrenal 80% adrenaline
 medulla: 20% noradrenaline



GIT : inhibition of wall
 cont. of sphincters
bl. vs : VC & weak VD

Pelvis

2 Lesser splanchnic nerves

1 presacral nerve

origin 12th thoracic & upper 3 lumbar
relay inferior mesenteric ganglion

U. bladder : Retention of urine

Rectum : Retention of faeces

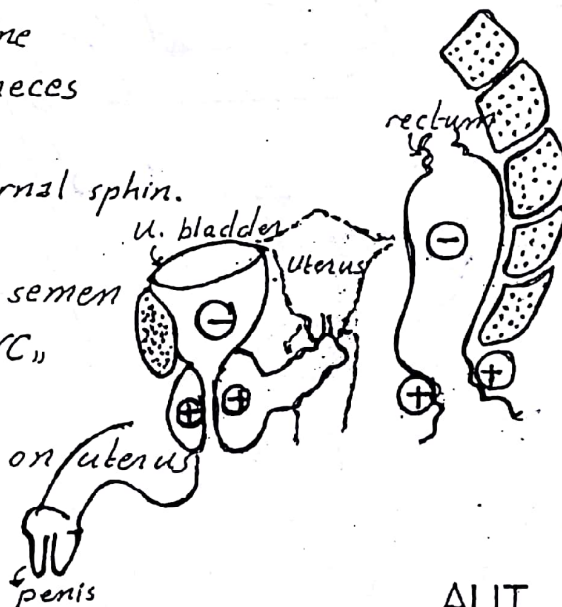
[relax of wall.
 cont. of internal sphin.

→

Ejaculation of semen

Shrinkage «VC»
 of penis

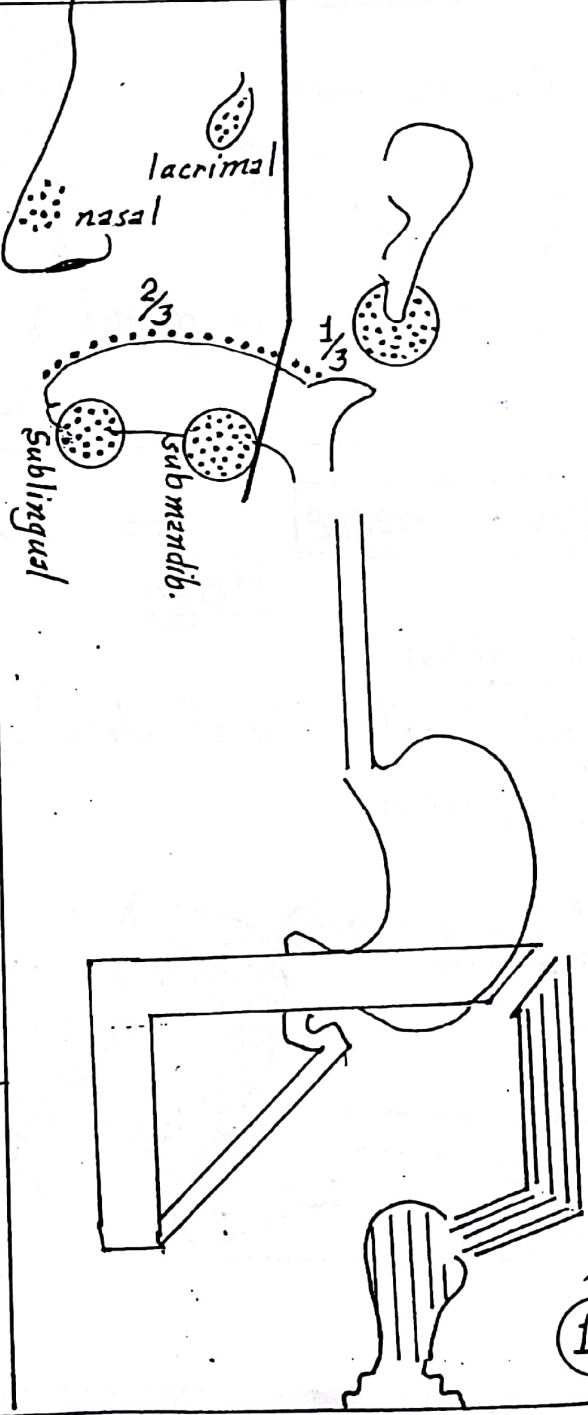
Variable effects on uterus



AUT

Functions of parasymp thetic n.s.

Secreto - Motor

Nucleus	Ganglion	Functions	
<u>Edinger Westphal</u> <u>III</u> <u>Oculomotor</u>	<u>Ciliary</u>	 Pupilloconstrictor muscle Ciliary muscle	
<u>Superior salivary</u> <u>VII</u> <u>Facial</u>	<u>Submandibular</u> <u>Spheno palatine</u>	 nasal lacrimal 2/3 1/3 sublingual submandib.	Salivary glands
<u>Inferior salivary</u> <u>IX</u> <u>Glossopharyngeal</u>	<u>Otic</u>		Gastro-intestinal
<u>VAGAL</u> <u>X</u> <u>Vagus</u>	<u>Terminal</u>		Pelvis
<u>2, 3 & 4 S</u> <u>segment</u> <u>Pelvic</u>	<u>Terminal</u>		

Aut

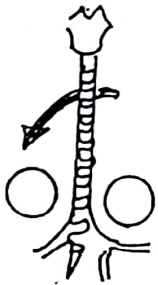
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VAGUS

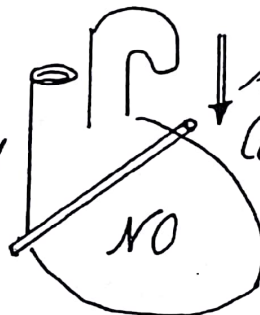
X
Relay

70% of parasymp
Terminal ganglia

Thorax



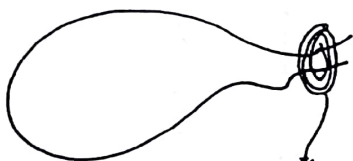
bronchoconstriction
++ bronchial secretion
Pulmonary VD



Atrial properties
Coronary VC

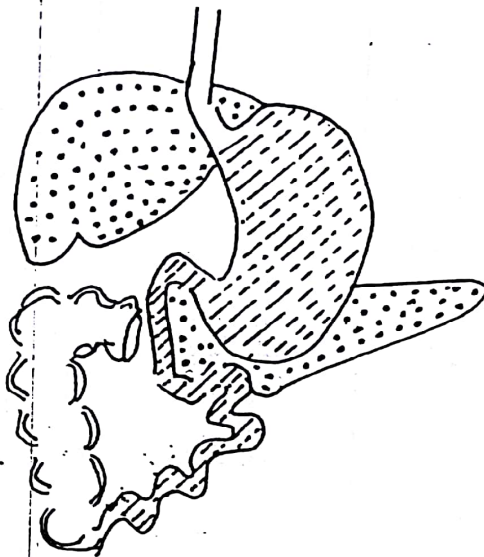
Abdomen

Evacuation.



Gall bladder

Oddi sphinct.



Pelvic nerve

=
Relay

Nervi erigentes
Terminal ganglia

Defecation

cont. of wall

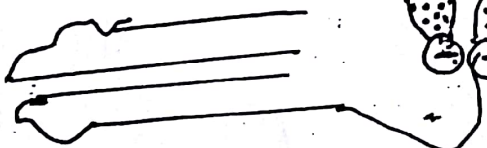
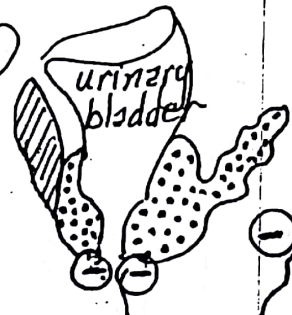
relax of internal sphincter

Micturition

Erection

Secretion

VD



rectum

Aut

(12)

Parasymp.

Sympathetic

• Glands

Secretory

except { sweat
salivary
endocrinal
e.g pancreas

• Smooth Muscles

Motor

Relaxation (inhibition)
of GIT
& Urinary system

except { pupillo dilator
spleen
Prostate &
seminal vesicle

VD

VC

• Cardiac Muscle

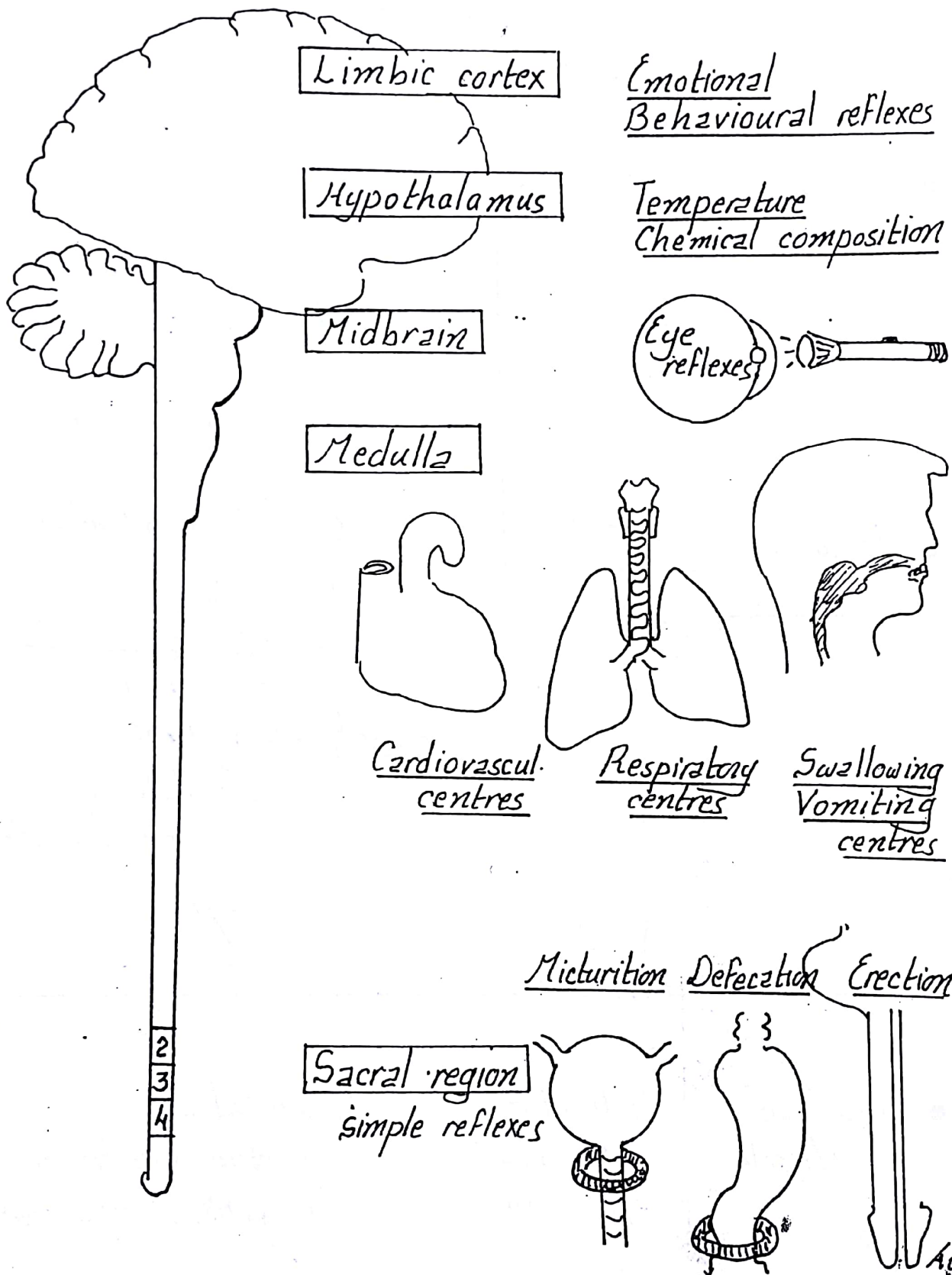
Inhibition
of atria
i.e -- HR

Stimulation
of atria & ventricles
i.e ++ HR & force of cont.

VC

VD

Centres of Autonomic Reflexes



Acetylcholine

Synthesis

- Terminal endings (knobs) of cholinergic nerves
- Choline : synthesised + active reuptake
- Acetate : activated by coenzyme A
- Acetyl CoA + Choline $\xrightarrow[\text{transferase}]{\text{choline acetyl}}$ Acetylcholine (Clear vesicle)



Release

Exocytosis

In response to an action potential $\rightarrow$ ++ permeability to Ca^{++}

Destruction

- Acetylcholine $\xrightarrow{\text{CHOLINE ESTERASES}}$ Acetate ions + Choline

Types

a True or specific : Cell mem. of cholinergic n. endings
Synaptic area (bound to collagen RBCs)

b Pseudo or nonspecific : Plasma

Functions

It localises the action of acetylcholine.

Anticholine esterase

a Reversible

[eserine
prostigmin

b Irreversible

[parathion
di iso propyl Fluorophosphate
(war poisons)

Site of formation of acetylcholine.

and cholinergic receptors

2 x 2

ANS
(15)

ParA → acetylcholine
preganglionic synapse

acetylcholine → somatic
→ sweat glands
ParA + vol. V. of S.M. } not ParA

● Acetylcholine -

○ Noradrenaline

CNS & SNS → Voluntary (somatic)

Central cholinergic fibres

□ All preganglionic autonomic
□ Somatic

Nicotinic Receptors

- skeletal muscles
- postganglionic neurones

Peripheral cholinergic fibres

□ All postganglionic parasymp
□ ② exceptional sympathetic N1 Ad.

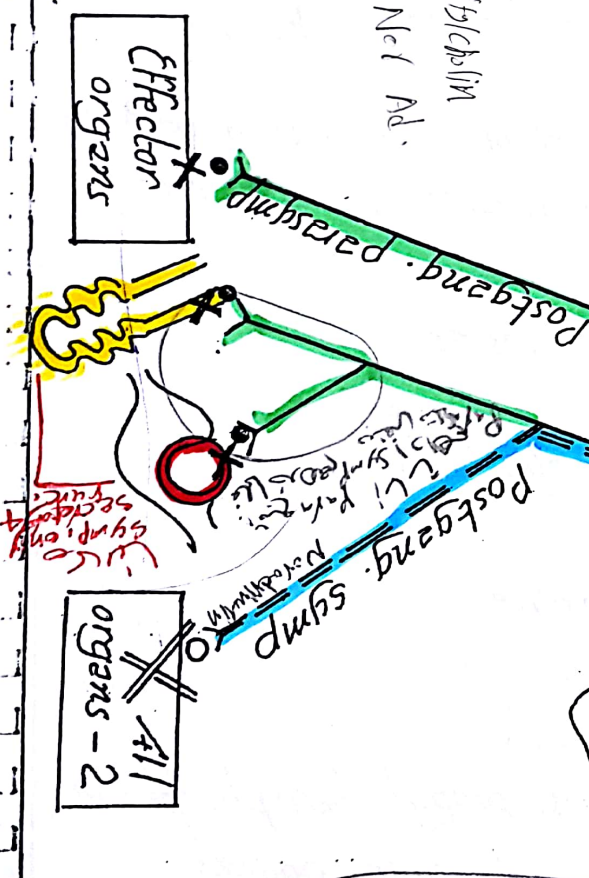
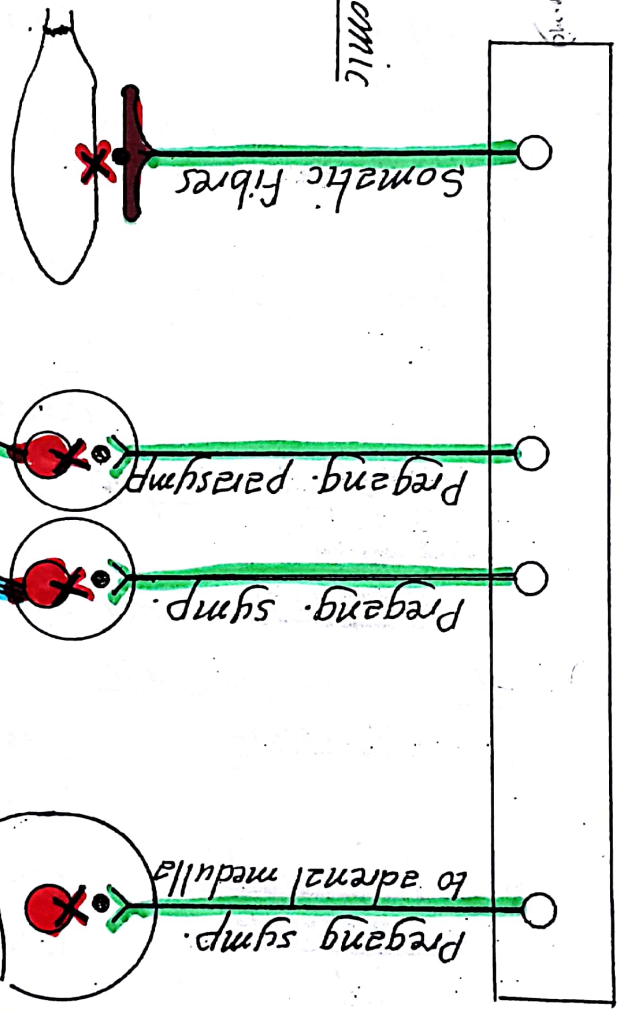
• sweat glands
• bl. vs of skeletal ms

Muscarinic Receptors

- All organs supplied by parasymp
- sweat glands & bl. vs of sk. ms

Central nervous system

Am 91



Ventricle, spleen, adrenal medulla

Right side of CV

Skin sympathetic S.M. 2

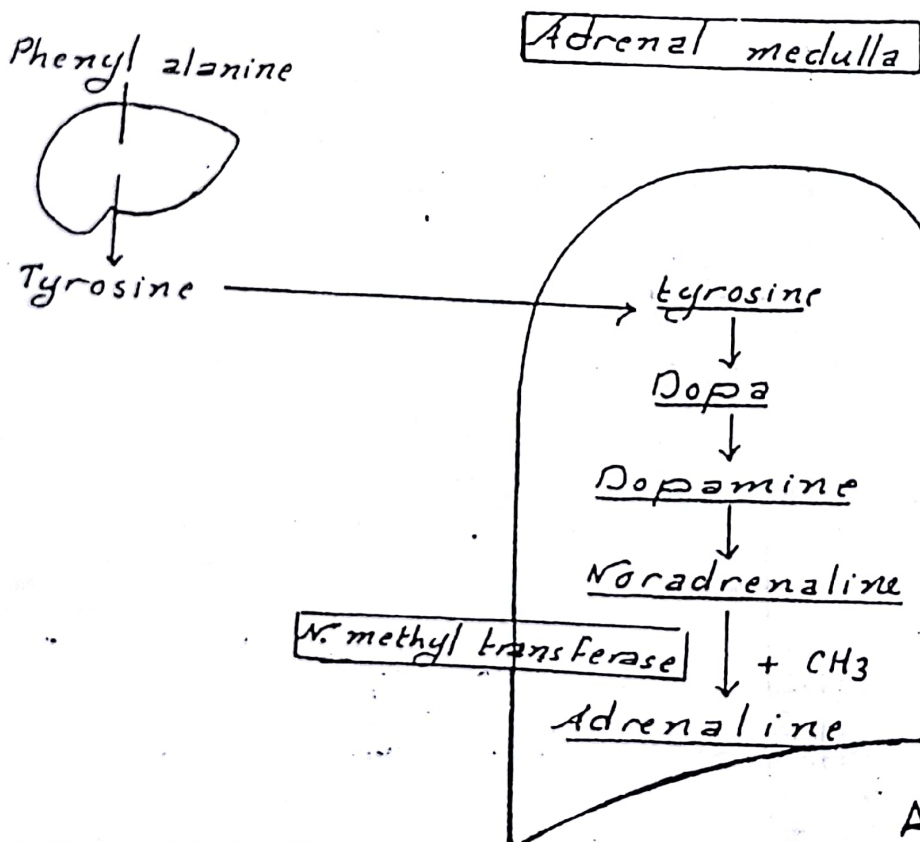
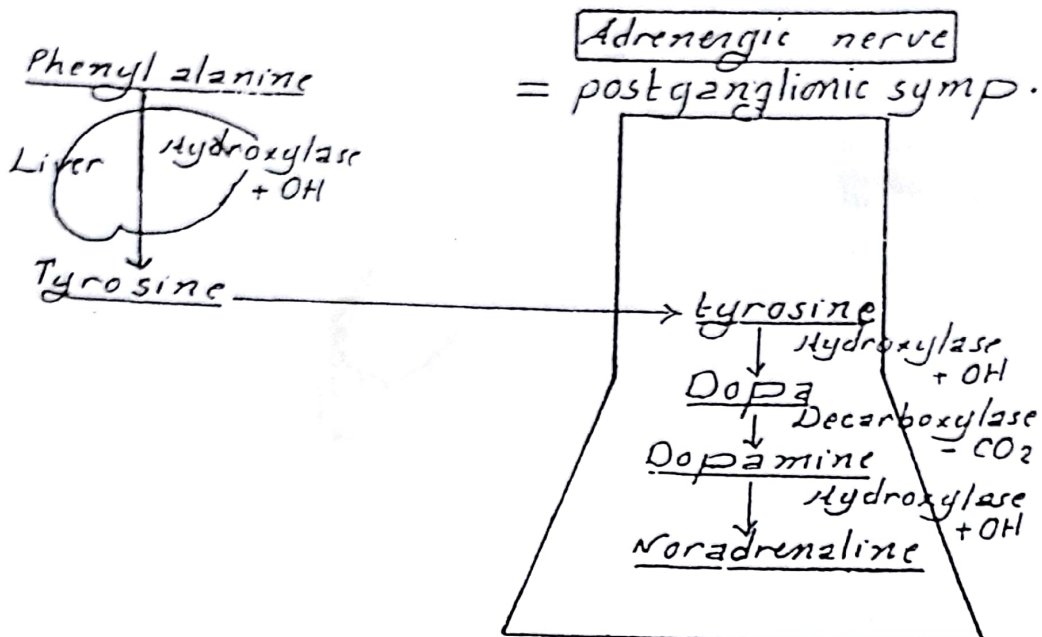
all somatic all pre. symp 2 Post. symp

motor system

<u>Cholinergic Receptors</u>	<u>Site</u>	<u>Stimulants</u>	<u>Blockers</u>
<u>① Central cholinergic</u> <u>Nicotinic R</u>	<u>1</u> <u>All ganglia</u> On postgang neurons Symp, Parasymp or Adrenal medulla <u>2</u> <u>Motor end plate</u> Neuro-muscular Junction On skeletal muscle	<u>① Nicotinic drugs</u> <u>Site Nicotinic R</u> e.g. <u>NSD</u>	<u>Acetylcholine</u> <u>Antagonists</u> <u>① Nicotinic blockers</u> <u>a) Ganglionic blockers</u> <u>Site All ganglia</u> e.g. <u>NLD</u> Tetraethyl ammonium <u>b) Neuro-musc. blockers</u> <u>Site neuro-musc. Jun.</u> e.g. <u>Curare</u>
<u>② Peripheral cholinergic</u> <u>Muscarinic R</u>	<u>1</u> <u>All organs supplied by postgang. parasymp.</u> <u>2</u> <u>Exceptional organs supplied by postgang. symp.</u> - Sweat glands - Blood vessels of skeletal muscles	<u>② Muscarinic drugs</u> <u>Site Muscarinic R</u> e.g. <u>Muscarine</u> <u>parasympathomimetics</u> <u>Anticholinesterases</u>	<u>② Muscarinic blockers</u> <u>Site Muscarinic R</u> e.g. <u>Atropine</u> <u>parasympatholytics</u> <u>1, 2 prevent the action</u> <u>is not formation of A.C.</u>

Noradrenaline

Formation

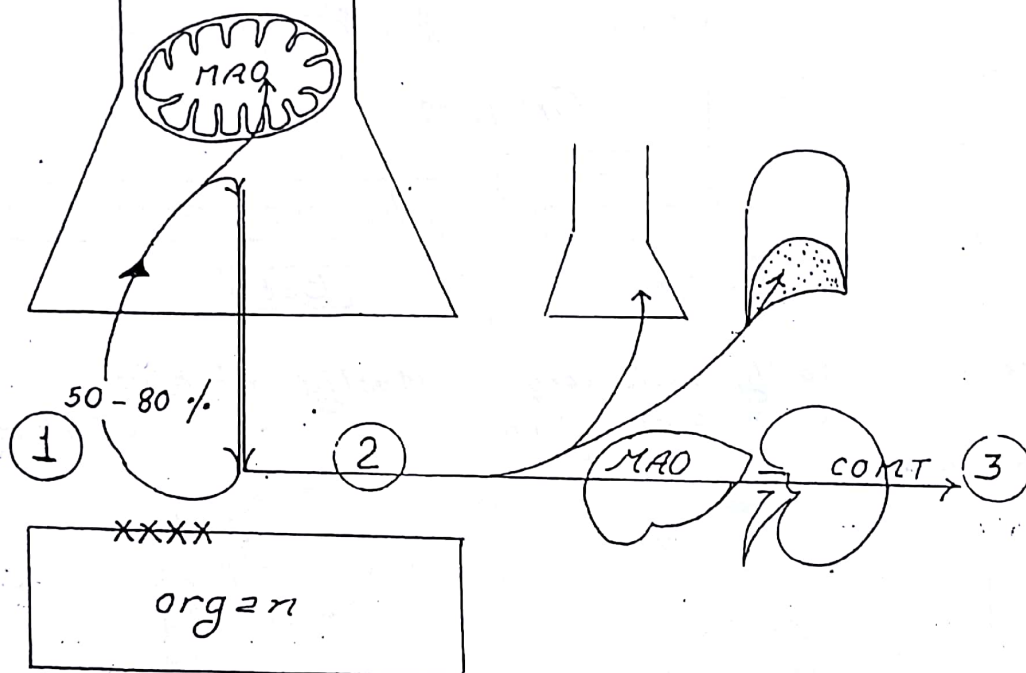


AUT

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Inactivation

Adrenergic nerve



① Active reuptake

② Diffusion

③ Destruction
Oxidation

Monoamine oxidase

Organelles: Mitochondria

Organs: Adrenergic nerves
Brain

Liver

Kidney

Denervation hypersensitivity
50 - 80 %

Away

Methylation

Catechol O methyl-
transferase

Liver

Kidney

AUT

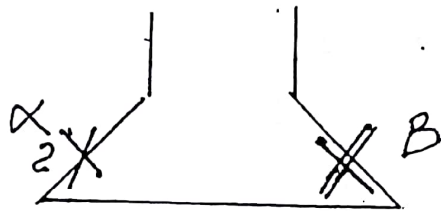
①9

Adrenergic receptors

Presynaptic adrenergic receptors

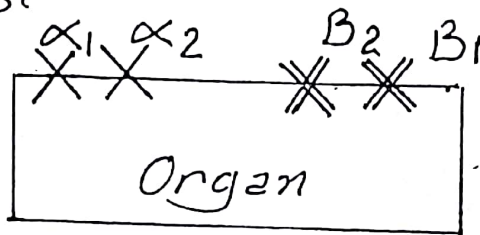
Adrenergic nerves

Presynaptic



Synapse

Postsynaptic



Postsynaptic adrenergic receptors

Alpha

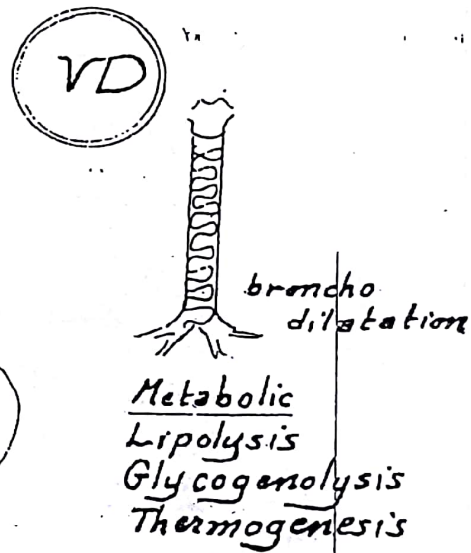
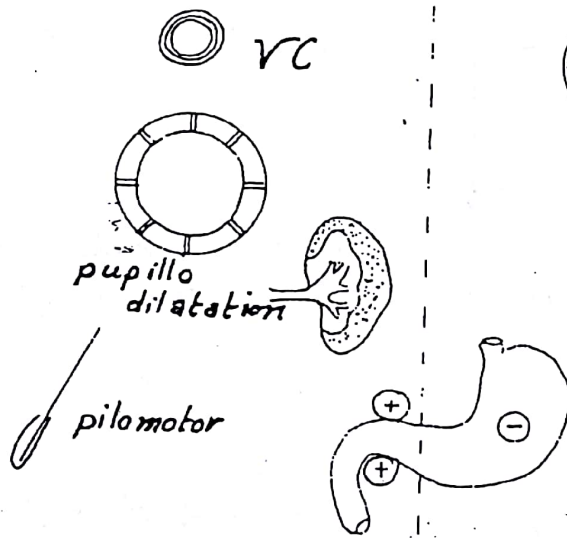
Beta

Action

Mostly excitatory
= contraction

Mostly inhibitory
= relaxation

Examples



Exception



AUT

(20)

Types :

Alpha 1 Rest

Beta 1 Heart & Lipolysis

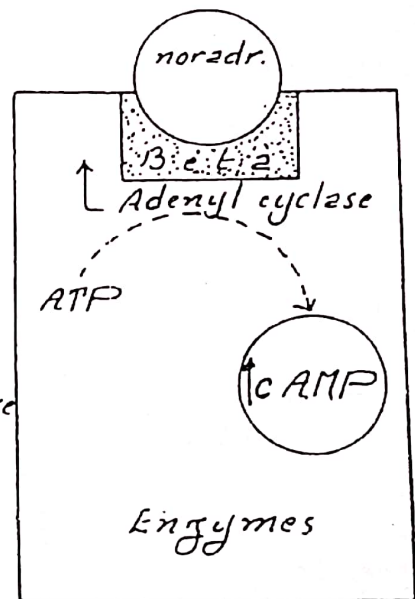
Alpha 2 VD & intest absorption

Beta 2 Rest

Mechanism of action:

Alpha 1 $\uparrow Ca^{++}$

Alpha 2 Inhibits
adenyl cyclase
 $\downarrow$ cAMP



Sensitivity to drugs

Alpha

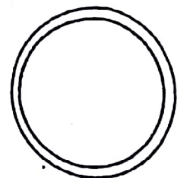
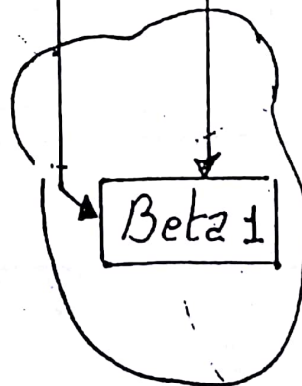
Noradrenaline

Adrenaline

Beta 2



VC



VD

Drugs affecting symp. n. s.

Drugs which
increase
symp. activity

Drugs which
decrease
symp. activity

A

Ganglia

Nicotine small dose



Nicotine large dose

B

Adrenergic n. ending

Ephedrine



Reserpine
Guanethidine
CH₃ dopa
(false ch. trans)

C

Receptors

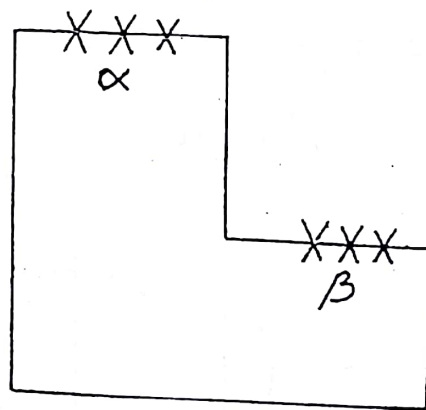
Alpha

Noradrenaline

Adrenaline

Beta

Isoprenaline



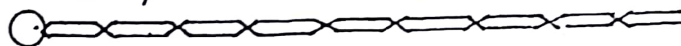
phentolamine

Dichloro
isoprenaline
Propranolol

AUT

The ganglia of relay

parasympathetic nervous system



One chemical transmitter

sympathetic nervous system



Two chemical transmitters
so impossible

Adrenal medulla

Items	Adrenaline	Noradrenaline
- %	80 % adrenal medulla	20 %
- Site of release	CNS	Sympathetic
- Chemical nature	+ CH ₃	- CH ₃
- Inactivation	Methylation	
- Receptors	B ₂ 	Alpha
- Action on CVS		
• Systolic (Heart-B ₁)	+	+
• Diastolic (TPR)	- VD -- TRR	+ VC ++ TPR
• HR	+ tachycardia	- bradycardia
• COP	+	- (23)
- Metabolism	More	Less